DESIGNING AND MAKING AN EXPERIMENTAL MODEL OF A NEBULIZATION DEVICE FOR LARGE SURFACE ENCLOSED SPACES

ROJIȘTEANU Vlad
Faculty of Industrial Engineering and Robotics, Specialization: Applied Informatics in Industrial Engineering
Year of study: IV, e-mail: vlad.rojisteanu@gmail.com

ABSTRACT: The present paper aims at developing a suitable solution for nebulization for large surface enclosed spaces. Due to the need created by the pandemic, an opportunity for disinfection of air and surfaces has risen on the global market of specialized devices. The device presented here allows air disinfection by its recirculation and its dispersion alongside with the substance used.

KEY WORDS: *decontamination technologies; disinfection; nebulisation equipment; Venturi nozzle.*

1. Introduction

The provoking experience of the pandemic which has impacted the last years has generated an acute need with a long-term effect for developing prevention and decontamination technologies.

For this purpose, rudimentary solutions were used, such as spraying alcohol or domestic disinfectant solutions or chloramines impregnation of the dust barriers placed at the entry of an enclosed space.

Gradually domestic and industrial technologies were developed.

UV lamps are being produced for industrial usage – automatized systems, and for personal use – pocket size. There are also robots or forced air recirculation systems.

Vermorel sprayers are also available in every possible type: manual operated, electric sprayer pump or compressed air sprayers.

Ozone generators are widely used, but there are disadvantages due to the volume limitations and the extremely slow intervention speed.

The technology presented in this study consists of cold fogging generation, which is the industrial nebulizer. The device sprays micron-sized particles in record time and with high efficiency. Cold (or dry) fogging generation technologies use mostly liquid disinfectants such as hydrogen peroxide (oxygenated water), peracetic acid dilutions, hypochlorous acid or compounds based on quaternary salts.

These are liquid substances with low viscosity and they can be dispersed in any enclosed space without any volume limit. This technology allows air and surface sanitation within the enclosed spaces.

This volumetric or tridimensional advantage is doubled by the wide spectrum of pathogenic agents which can be eliminated: viruses, bacteria, fungi and spores.

2. State of the Art

The disinfection devices using nebulization technology consists of a nebulizer which transforms the disinfection solution into thin aerosols which are dispersed within the enclosed spaces and on surfaces. This is an efficient method for destroying bacteria, viruses and other pathogenic

agents and it can be used in a variety of environments such as hospitals, schools, offices and other public spaces.

There is a variety of nebulizers available on the international disinfection equipment market. One of these equipments is the following:

Victory Innovations Cordless Electrostatic Sprayer: This is a portable battery-powered nebulizer which uses the electrostatic charging technology for spraying the disinfectant solutions as aerosols on the surfaces. I consider that its portability constitutes an advantage for usage in small enclosed spaces such as inside cars, buses, trucks or other means of transportation. However, its portability also constitutes a disadvantage, because it has to use a battery, thus its dispersion power is low; also, it does not have a way to recirculate the air, thus the space will continue to be contaminated. [1]

I have emphasized this solution due to its portability, and in order to highlight the advantages and disadvantages of the existing market equipment solutions.

3. The proposed solution

I am using a principle known for centuries, which is charging a liquid solution and spraying it in a dry fogging using the Ventury effect. Thus, the proposed solution uses a 1900W engine combined with a peristaltic pump of high precision made by BINACA PUMPS. It can cover an enclosed space up to 3000 cubic meters in one take.

The peristaltic pump helps dosing the solution so as to efficiently use the liquid.

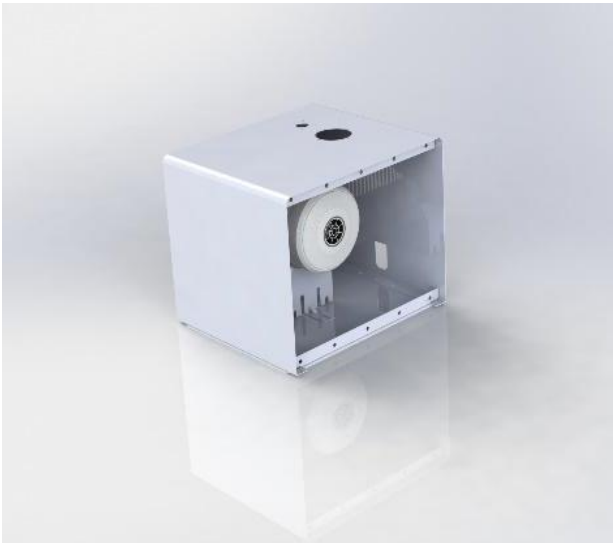

Fig. 1. Model

The equipment will be made from 316L type stainless steel. The stainless steel was chosen due to the fact that it does not react in contact with concentrated hydrogen peroxide (which is the most efficient disinfectant solution).

Currently I am still working on calibrating the Venturi nozzle.

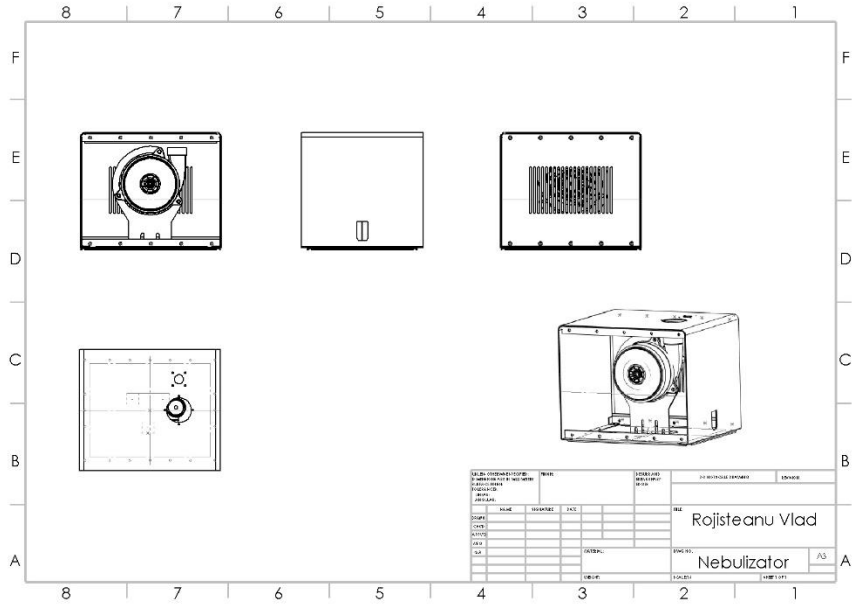

Fig. 2. Model

I consider that the equipment's interface to be very friendly and intuitive. At the moment, the equipment looks as it follows:

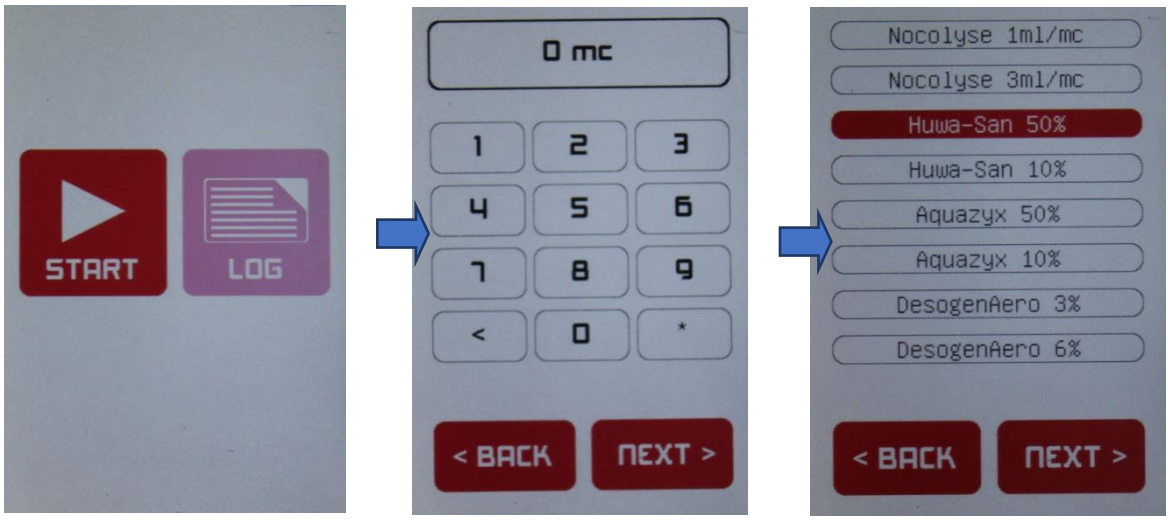

Fig. 3. Interface

After selecting the volume and the solution to use, I have set a delay in program initiation in order to allow the operator to leave the enclosed space. Regardless of the solution used, no person or animal must be present during the process in the enclosed space being disinfected.

4. Conclusions

My personal contribution refers to the design from scratch of the case and the assembly. For the software development I have used as interface a Arduino Due microcontroller board. I have chosen and I have assured the compatibility of all electric components according to the list below:

Nr crt	Name	Link
1	Engine	491 - Tangential | Domel
2	Peristaltic Pump	PP-5 Peristaltic Pump - Binaca Pumps
3	Power source	RS-25-12 - Mean Well - AC/DC Enclosed Power Supply (PSU), ITE, 1 Outputs (farnell.com)
4	Case	Laserhub - Ihr digitaler Komplettanbieter für Metallteile
5	Venturi nozzle	Strung local/ 3d print
7	Arduino	A000062 - Arduino - Single Board Computer, Arduino Due, AT91SAM3X8E (farnell.com)

5. References

[1]Professional Cordless Electrostatic Handheld Sprayer – Victory Innovations